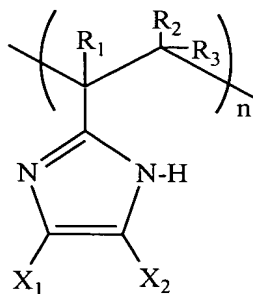


CLAIMS

- 1 1. A proton exchange membrane for a fuel cell wherein the
2 proton exchange membrane comprises:
3 a polyimidazole polymer of the type:



- 4 wherein R_1 – R_3 are independently H, a halogen, alkyl, or substituted
5 alkyl; and wherein X_1 and X_2 are independently H or an electron withdrawing
6 group.

- 1 2. The membrane of claim 1, wherein R_1 – R_3 are independently H
2 or a C_1 – C_5 alkyl.

- 1 3. The membrane of claim 1, wherein at least one of X_1 and X_2 is
2 an electron donating group.

- 1 4. The membrane of claim 1, wherein X_1 and X_2 are
2 independently: NR_3^+ , SR_2^+ , NO_2 , SO_2R , CN , SO_2Ar , $COOR$, $NRCOR$, OR ,
3 SR , $C\equiv CR$, Ar , $CR=CR_2$; wherein R is: H, alkyl, or substituted alkyl, and
4 wherein Ar is an aromatic group.

1 5. The membrane of claim 1 further including a polar solvent
2 dissolved therein.

1 6. The membrane of claim 5 wherein said polar solvent is selected
2 from the group consisting of N-methylpyrrolidone, dimethylformamide,
3 dimethylsulfoxide, and combinations thereof.

1 7. The membrane of claim 1, further including a dopant.

1 8. The membrane of claim 7, wherein said dopant comprises a
2 strong acid.

1 9. The membrane of claim 8, wherein said strong acid is selected
2 from the group consisting of nitric acid, phosphoric acid, polyphosphoric acid,
3 sulfuric acid, and combinations thereof.

1 10. The membrane of claim 8, wherein said strong acid is an
2 organic acid.

1 11. The membrane of claim 1, wherein said polymer has a
2 molecular weight in the range of 5×10^3 - 10^7 daltons.

1 12. The membrane of claim 1, wherein said membrane has a
2 thickness in the range of 25-200 microns.

1 13. The membrane of claim 1, wherein said membrane has an
2 electrical conductivity greater than 0.01 S/cm.

1 14. The membrane of claim 1, wherein said polyimidazole polymer
2 is copolymerized with an acidic monomer.

1 15. The membrane of claim 14, wherein said acidic monomer is an
2 acidic vinyl monomer.

1 16. The membrane of claim 15, wherein said acidic vinyl monomer
2 is selected from the group consisting of: vinyl phosphonic acid, vinyl sulfonic
3 acid, styrene sulfonic acid, and combinations thereof.

1 17. The membrane of claim 1, wherein R_1 – R_3 are fluorine.

1 18. The membrane of claim 1, further including a heteropolyacid.

1 19. The membrane of claim 18, wherein said heteropolyacid is
2 selected from the group consisting of: monododecylphosphate, phosphotungstic
3 acid, silicotungstic acid, phosphomolybdic acid, and combinations thereof.

1 20. The membrane of claim 18, wherein said heteropolyacid is
2 adsorbed on a carrier which is dispersed in said polymer.

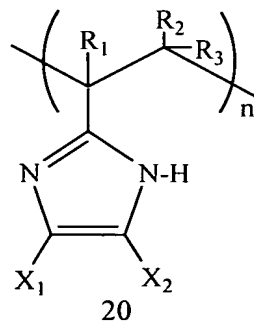
1 21. The membrane of claim 20, wherein said carrier comprises
2 silica.

1 22. The membrane of claim 1 further including a silicon compound
2 therein.

1 23. The membrane of claim 22, wherein said silicon compound
2 comprises SiO₂.

1 24. The membrane of claim 22, wherein said silicon compound
2 comprises a network of -Si-O-Si- which extends through at least a portion of
3 said membrane.

1 25. A fuel cell having a proton exchange membrane, said membrane
2 comprising a polyimidazole polymer of the type:



3 wherein R_1 – R_3 are independently H, a halogen, alkyl, or a substituted
4 alkyl; and wherein X_1 and X_2 are independently H or an electron withdrawing
5 group.

1 26. The fuel cell of claim 25, wherein X_1 and X_2 are each CN.

1 27. The fuel cell of claim 25, wherein said membrane further
2 includes a polar solvent dissolved therein.

1 28. The fuel cell of claim 25, wherein said membrane further
2 includes a dopant therein.

1 29. The fuel cell of claim 25, wherein said dopant comprises a
2 strong acid.

1 30. The fuel cell of claim 29, wherein said strong acid is selected
2 from the group consisting of nitric acid, phosphoric acid, polyphosphoric acid,
3 sulfuric acid, and combinations thereof.

1 31. The fuel cell of claim 25, wherein said membrane comprises a
2 copolymer of said polyimidazole polymer and another material.